Public Law 85-500
85th Congress, S. 3910
July 3, 1958

AN ACT

72 Stat. 297.

Authorizing the construction, repair, and preservation of certain public works on rivers and harbors for navigation, flood control, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

TITLE I—RIVERS AND HARBORS

River and Harbor Act of 1958.

SEC. 101. That the following works of improvement of rivers and harbors and other waterways for navigation, flood control, and other purposes are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and supervision of the Chief of Engineers, in accordance with the plans and subject to the conditions recommended by the Chief of Engineers in the respective reports hereinafter designated: *Provided*, That the provisions of section 1 of the River and Harbor Act approved March 2, 1945 (Public Law Numbered 14, Seventy-ninth Congress, first session), shall govern with respect to projects authorized in this title; and the procedures therein set forth with respect to plans, proposals, or reports for works of improvement for navigation or flood control and for irrigation and purposes incidental thereto, shall apply as if herein set forth in full:

59 Stat. 10.

NAVIGATION

Maine and Massachusetts.

Josias River, Maine: House Document Numbered 377, Eighty-fifth Congress, at an estimated cost of $258,400;

Salem Harbor, Massachusetts: House Document Numbered 31, Eighty-fifth Congress, at an estimated cost of $1,100,000;

Boston Harbor, Massachusetts: House Document Numbered 349, Eighty-fourth Congress, at an estimated cost of $720,000;

East Boat Basin, Cape Cod Canal, Massachusetts: House Document Numbered 168, Eighty-fifth Congress, at an estimated cost of $360,000;

Connecticut.

Bridgeport Harbor, Connecticut: House Document Numbered 136, Eighty-fifth Congress, at an estimated cost of $2,300,000;

New York.

New York Harbor, New York: Senate Document Numbered 45, Eighty-fourth Congress, at an estimated cost of $1,678,000;

Maryland.

Baltimore Harbor and Channels, Maryland: House Document Numbered 86, Eighty-fifth Congress, at an estimated cost of $28,161,000;

Herring Creek, Maryland: House Document Numbered 159, Eighty-fourth Congress, at an estimated cost of $110,000;

Betterton Harbor, Maryland: House Document Numbered 333, Eighty-fourth Congress, at an estimated cost of $78,000;

Delaware River anchorages.

Delaware River Anchorages: House Document Numbered 185, Eighty-fifth Congress, at an estimated cost of $24,447,000;

Virginia.

Hull Creek, Virginia: House Document Numbered 287, Eighty-fifth Congress, at an estimated cost of $269,800;

North Carolina.

Morehead City Harbor, North Carolina: Senate Document Numbered 54, Eighty-fourth Congress, at an estimated cost of $1,197,000;

Florida.

Intracoastal Waterway, Jacksonville to Miami, Florida: House Document Numbered 222, Eighty-fifth Congress, maintenance;

Port Everglades Harbor, Florida: House Document Numbered 346, Eighty-fifth Congress, at an estimated cost of $6,683,000;

Escambia River, Florida: House Document Numbered 75, Eighty-fifth Congress, at an estimated cost of $61,000;

Mississippi.

Gulfport Harbor, Mississippi: Senate Document Numbered 123, Eighty-fourth Congress, maintenance;

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Louisiana.

Barataria Bay, Louisiana: House Document Numbered 82, Eighty-fifth Congress, at an estimated cost of $1,647,000;

Chefuncte River and Bogue Falia, Louisiana: Senate Document Numbered 54, Eighty-fifth Congress, at an estimated cost of $48,000;

Texas.

Pass Cavallo to Port Lavaca, Texas: House Document Numbered 131, Eighty-fourth Congress, at an estimated cost of $413,000;

Galveston Harbor and Houston Ship Channel, Texas: House Document Numbered 350, Eighty-fifth Congress, at an estimated cost of $17,196,000;

Matagorda Ship Channel, Port Lavaca, Texas: House Document Numbered 388, Eighty-fourth Congress, at an estimated cost of $9,944,000;

Port Aransas-Corpus Christi Waterway, Texas: House Document Numbered 361, Eighty-fifth Congress, at an estimated cost of $6,272,000;

Port Aransas-Corpus Christi Waterway, Texas, La Quinta Channel: Senate Document Numbered 33, Eighty-fifth Congress, at an estimated cost of $954,000;

Freeport Harbor, Texas: House Document Numbered 433, Eighty-fourth Congress, at an estimated cost of $317,000;

Mississippi River.

Mississippi River between Missouri River and Minneapolis, Minnesota, damage to levee and drainage districts: House Document Numbered 135, Eighty-fourth Congress, at an estimated cost of $2,476,000;

Illinois.

Mississippi River at Alton, Illinois, commercial harbor: House Document Numbered 136, Eighty-fourth Congress, at an estimated cost of $246,000;

Mississippi River at Alton, Illinois, small-boat harbor: House Document Numbered 136, Eighty-fourth Congress, at an estimated cost of $101,000;

Iowa.

Mississippi River at Clinton, Iowa, Beaver Slough: House Document Numbered 345, Eighty-fourth Congress, at an estimated cost of $241,000;

Mississippi River at Clinton, Iowa, report on damages: House Document Numbered 412, Eighty-fourth Congress, at an estimated cost of $147,000;

Missouri.

Mississippi River between Saint Louis, Missouri, and Lock and Dam Numbered 26: Senate Document Numbered 7, Eighty-fifth Congress, at an estimated cost of $5,802,000;

Minnesota.

Mississippi River between the Missouri River and Minneapolis, Minnesota: Modification of the existing project in the Mississippi River at Saint Anthony Falls, Minneapolis, Minnesota, House Document Numbered 33, Eighty-fifth Congress;

Minnesota River, Minnesota: Senate Document Numbered 144, Eighty-fourth Congress, at an estimated cost of $2,539,000: *Provided*, That the channel may be extended five-tenths of a mile upstream to mile 14.7 at an estimated additional cost of $5,000;

Ohio.

Vermilion Harbor, Ohio: House Document Numbered 231, Eighty-fifth Congress, at an estimated cost of $474,000;

Ohio River at Gallipolis, Ohio: House Document Numbered 423, Eighty-fourth Congress, at an estimated cost of $66,000;

Kentucky.

Licking River, Kentucky: House Document Numbered 434, Eighty-fourth Congress, maintenance;

Wisconsin.

Saxon Harbor, Wisconsin: House Document Numbered 169, Eighty-fifth Congress, at an estimated cost of $393,500;

Two Rivers Harbor, Wisconsin: House Document Numbered 362, Eighty-fourth Congress, at an estimated cost of $66,000;

Port Washington Harbor, Wisconsin: House Document Numbered 446, Eighty-third Congress, at an estimated Federal cost of $2,181,000: *Provided*, That local interests shall contribute 30 per cent of the total cost of the project;

85TH CONGRESS } 1st Session — SENATE — { DOCUMENT No. 7

MISSISSIPPI RIVER BETWEEN ST. LOUIS, MO., AND LOCK AND DAM NO. 26

LETTER

FROM

THE SECRETARY OF THE ARMY

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY, DATED AUGUST 13, 1956, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS, ON A REVIEW OF REPORT ON MISSISSIPPI RIVER BETWEEN ST. LOUIS, MO., AND LOCK AND DAM NO. 26, REQUESTED BY A RESOLUTION OF THE COMMITTEE ON PUBLIC WORKS, UNITED STATES SENATE, ADOPTED ON DECEMBER 6, 1955

PRESENTED BY MR. CHAVEZ

JANUARY 9 (legislative day, JANUARY 3), 1957.—Referred to the Committee on Public Works and ordered to be printed, with illustrations

UNITED STATES
GOVERNMENT PRINTING OFFICE
80403 WASHINGTON : 1957

LETTER OF TRANSMITTAL

DEPARTMENT OF THE ARMY,
Washington 25, D. C., December 27, 1956.

Hon. DENNIS CHAVEZ,
Chairman, Committee on Public Works,
United States Senate, Washington 25, D. C.

DEAR MR. CHAIRMAN: I am transmitting herewith a favorable interim report dated August 13, 1956, from the Chief of Engineers, Department of the Army, together with accompanying papers and illustrations, on a review of report on Mississippi River between St. Louis, Mo., and lock and dam No. 26, requested by a resolution of the Committee on Public Works, United States Senate, adopted December 6, 1955.

In accordance with the provisions of section 1 of Public Law 14, 79th Congress, and Public Law 732, 79th Congress, the views of the Governors of Illinois and Missouri are set forth in the enclosed communications, together with the views of the Department of the Interior in accordance with Public Law 732, 79th Congress.

Although the Bureau of the Budget advises that there is no objection to the submission of the report to Congress, it states that no commitment can be made at this time as to when any estimate of appropriation would be submitted for the construction of the project, if authorized by the Congress, since this would be governed by the President's budgetary objectives as determined by the then prevailing fiscal situation. The complete views of the Bureau of the Budget are contained in the attached copy of its letter.

Sincerely yours,

WILBER M. BRUCKER,
Secretary of the Army.

COMMENTS OF THE BUREAU OF THE BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT,
BUREAU OF THE BUDGET,
Washington 25, D. C., December 10, 1956.

The honorable the SECRETARY OF THE ARMY.

MY DEAR MR. SECRETARY: Assistant Secretary Roderick's letter of August 21, 1956, submits the proposed report of the Acting Chief of Engineers on Mississippi River between St. Louis, Mo., and lock and dam No. 26, requested by a resolution of the Senate Public Works Committee, adopted December 6, 1955.

The Acting Chief of Engineers recommends modification of the existing project for the Mississippi River between the Ohio and Missouri Rivers to provide for the construction of a rockfill dam across the Mississippi River approximately 900 feet downstream from the Chain of Rocks Highway Bridge. The total cost, all Federal, is estimated at $5,810,000, including $8,000 for aids to navigation. The annual carrying charges are estimated at $516,000, including $300,000 for dredging, revetment, and dam maintenance, and $2,500 for maintenance of navigation aids. The annual benefits are estimated at $2,570,000 consisting of $1,425,000 for elimination of losses due to reduced draft, $906,000 for reduction in loss due to lightering and idling of equipment, and $239,000 for elimination of other business losses. The benefit-cost ratio is stated to be 5.0. It is estimated that the fixed-crest rockfill dam could be constructed in from 16 to 24 months.

At our request, the Corps of Engineers furnished supplemental data concerning certain aspects of the improvement which are not adequately covered in the report. On the basis of these data and in view of the recognized need for effective remedial measures in the interest of important existing navigation, I am authorized by the Director of the Bureau of the Budget to advise you that there would be no objection to the submission of the report to the Congress. However, no commitment can be made at this time as to when any estimate of appropriation would be submitted for the construction of the project, if authorized by the Congress, since this would be governed by the President's budgetary objectives, as determined by the then prevailing fiscal situation.

Sincerely yours,

CARL H. SCHWARTZ, Jr.,
Chief, Resources and Civil Works Division.

COMMENTS OF THE GOVERNOR OF ILLINOIS

THE STATE OF ILLINOIS,
OFFICE OF THE GOVERNOR,
Springfield, July 27, 1956.

The CHIEF OF ENGINEERS,
Corps of Engineers,
Department of the Army,
Washington 25, D. C.

DEAR SIR: On June 29, 1956, in accordance with the provisions of Public Laws 14 and 732, 79th Congress, you transmitted to the State of Illinois, for official comment, a copy of your proposed report, on an Interim Report on Mississippi River between St. Louis, Mo., and lock and dam No. 26 for Navigation.

Your proposed report has been carefully reviewed by the State Water Resources and Flood Control Board. The Board recommends concurrence in the recommendations of your report.

We therefore concur in your recommendation that the existing project for the Mississippi River between the Ohio and Missouri Rivers be modified to provide for the construction of a rockfill dam across the Mississippi River some 900 feet downstream from the Chain of Rocks Highway Bridge.

Sincerely,

WILLIAM G. STRATTON, *Governor.*

COMMENTS OF THE GOVERNOR OF MISSOURI

EXECUTIVE OFFICE,
STATE OF MISSOURI,
Jefferson City, July 13, 1956.

Lt. Gen. S. D. STURGIS, Jr.,
Department of the Army,
Washington 25, D. C.

DEAR GENERAL STURGIS: I have received the review of the report on the Mississippi River between St. Louis, Mo., and lock and dam No. 26 reviewed by Mr. R. E. Duffy, chief engineer of the Missouri Public Service Commission, who has been handling this matter for me of late.

Mr. Duffy reports that he made a visit yesterday to the areas that may be considered as relative to the problems you have before you and has recommended that I approve the corps' plan of improvement as discussed in that report and designated as the fixed-crest rockfill plan. He further advises that the city of St. Louis has indicated its concurrence in the plan.

After carefully considering all the factors involved, I concur in the recommendations of the report to construct the fixed-crest overflow type dam in the Mississippi River about 900 feet below Chain of Rocks Highway Bridge.

Sincerely,

PHIL M. DONNELLY, *Governor.*

COMMENTS OF THE DEPARTMENT OF THE INTERIOR

DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington 25, D. C., August 6, 1956.

Lt. Gen. S. D. STURGIS, Jr.,
Chief of Engineers,
Department of the Army, Washington 25, D. C.

DEAR GENERAL STURGIS: This is in reply to your letter of June 29, transmitting to this Department for comment copy of your proposed report, together with the reports of the Board of Engineers for Rivers and Harbors, and of the district and division engineers, on an interim report on Mississippi River between St. Louis, Mo., and lock and dam No. 26.

Your report recommends modification of the existing project for the Mississippi River between the Ohio and Missouri Rivers to provide for the construction of a rockfill dam across the Mississippi River approximately 900 feet downstream from the Chain of Rocks Highway Bridge at an estimated cost to the United States of $5,802,000 for construction.

The Fish and Wildlife Service advises that the proposed construction would not adversely affect fish and wildlife resources. Also, other interests of this Department would not be adversely affected.

The opportunity of commenting on your report is appreciated.

Sincerely yours,

FRED G. AANDAHL,
Assistant Secretary of the Interior.

MISSISSIPPI RIVER BETWEEN ST. LOUIS, MO., AND LOCK AND DAM NO. 26

REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY

DEPARTMENT OF THE ARMY,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington 25, D. C., August 13, 1956.

Subject: Mississippi River between St. Louis, Mo., and lock and dam No. 26.

To: The Secretary of the Army.

1. I submit herewith for transmission to Congress the report of the Board of Engineers for Rivers and Harbors in response to resolution of the Committee on Public Works of the United States Senate, adopted December 6, 1955, requesting the Board to review the report of the Chief of Engineers on the Mississippi River between Ohio River and mouth of Missouri River, submitted as House Document No. 231, 76th Congress, 1st session, and other reports, with a view to determining the advisability of modifying the existing project at the present time, with particular reference to the needs of navigation in the reach of the river between St. Louis, Mo., and lock and dam No. 26.

2. After full consideration of the reports secured from the district and division engineers, the Board recommends modification of the existing project for the Mississippi River between the Ohio and Missouri Rivers to provide for the construction of a rockfill dam across the Mississippi River approximately 900 feet downstream from the Chain of Rocks Highway Bridge; generally in accordance with the plan of the district engineer and with such modifications thereof as, in the discretion of the Chief of Engineers, may be advisable; at an estimated cost to the United States of $5,802,000 for construction and $300,000 for annual maintenance in addition to that now required.

3. After due consideration of these reports, I concur in the views and recommendations of the Board.

CHAS. G. HOLLE,
Major General, USA, Acting Chief of Engineers.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

CORPS OF ENGINEERS, UNITED STATES ARMY,
BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington 25, D. C., June 19, 1956.

Subject: Mississippi River between St. Louis, Mo., and lock and dam No. 26.

To: The Chief of Engineers, Department of the Army.

1. This interim report is submitted in response to the following resolution adopted December 6, 1955:

Resolved by the Committee on Public Works of the United States Senate, That the Board of Engineers for Rivers and Harbors, created under section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby, requested to review the report of the Chief of Engineers on the Mississippi River between Ohio River and mouth of Missouri River, submitted as House Document Numbered 231, Seventy-sixth Congress, First Session, and other reports, with a view to determining the advisability of modifying the existing project at the present time, with particular reference to the needs of navigation in the reach of the river between St. Louis, Missouri, and Lock and Dam No. 26.

2. The Mississippi River is improved for barge navigation from the Gulf of Mexico to Minneapolis, Minn. Lock and dam No. 26, 202.7 miles above the mouth of the Ohio River, is the lowermost dam on the Mississippi River. Below this dam the river has been improved by open-river regulation and dredging. The Missouri River enters from the west 7.7 miles below lock and dam No. 26. The present Federal project for the reach between St. Louis, Mo., and lock and dam No. 26 provides for a channel 9 feet deep in the Mississippi River and through the Chain of Rocks lateral canal which lies parallel to the Mississippi River on the left bank between miles 194 and 184.

3. Waterborne commerce on the middle and upper Mississippi River developed rapidly after completion of the slack-water project on the Mississippi and Illinois Rivers. At lock and dam No. 26 commerce passing through the lock increased from 1.4 million tons in 1938 to 15.2 million tons in 1955. Lockages to pass this commerce have increased from 2,487 in 1938 to 6,296 in 1955. Vessels operating in this section of the river range from small recreational craft to large towboats and barges. The latter have drafts up to 9 feet although some of the newer barges are loaded to drafts of 10 feet or more if river stages permit.

4. Local interests desire construction of remedial works to assure the 9-foot project depth over the lower sill of lock No. 26 during periods of low flow. Waterway operators and shippers claim they have suffered substantial monetary losses because of light loading of barges, the necessity of using additional barges to maintain normal delivery schedules, and shortage of materials in certain localities due to delayed shipments. They also claim loss of revenue because of diversion of shipments to other means of transportation.

5. The district engineer states that the elevation of the low-water plane through St. Louis Harbor and the Chain of Rocks section has decreased steadily over many years as a result of channel constriction and scour, and the reach between the mouth of the Missouri River and lock and dam No. 26 has lowered rapidly since about 1932. This action, together with subnormal discharges during several recent winters, has reduced the available depth over the lower sill of lock No. 26 to less than the authorized project depth of 9 feet for relatively

long periods. The district engineer considers that the construction of a rockfill dam across the Mississippi River about 900 feet below the Chain of Rocks Highway Bridge represents the most practicable earliest solution, at minimum initial cost, to the urgent problem of providing adequate navigable depths over the lower sill at lock No. 26. The dam would be 2,760 feet long with crest elevation at 395 feet. A 700-foot spillway section, with crest at elevation 387.7, is designed to provide desired channel depths at lock and dam No. 26 with low flow of about 40,000 cubic feet per second. The district engineer estimates the Federal first cost at $5,810,000 including $8,000 for aids to navigation. The annual charges would be $516,000, including $300,000 for dredging, revetment, and dam maintenance, and $2,500 for maintenance of navigation aids. He estimates the annual benefits at $2,570,000 consisting of $1,425,000 for elimination of loss due to reduced draft, $906,000 for reduction in loss due to lightering and idling of equipment, and $239,000 for elimination of other business losses. The benefit-cost ratio is 5. The district engineer recommends that a fixed-crest rockfill dam with 700-foot spillway be constructed approximately 900 feet below Chain of Rocks Bridge at an estimated first cost to the Federal Government of $5,810,000, that funds be made available at the earliest practicable date for initiation of construction, and that continuing study be made of the problems to determine the most efficient comprehensive plan of development for this section of the Mississippi River, including the need for additional lockage facilities at dam No. 26. The division engineer concurs.

6. Local interests were notified of the recommendations of the reporting officers and given an opportunity to present additional information to the Board. Careful consideration has been given to the communications received.

VIEWS AND RECOMMENDATIONS OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

7. The Board of Engineers for Rivers and Harbors concurs in general in the views of the reporting officers. Progressive lowering of the low-water plane below lock and dam No. 26 has resulted in prolonged periods when less than project depth is available over the lower sill of lock No. 26. Increased commerce passing through this reach, in addition to the practice of year-round navigation, has created an urgency for remedial work. The proposed rockfill dam, providing an immediate solution of the problem, is warranted for accomplishment at Federal expense.

8. Therefore, the Board recommends modification of the existing project for the Mississippi River between the Ohio and Missouri Rivers to provide for the construction of a rockfill dam across the Mississippi River approximately 900 feet downstream from the Chain of Rocks Highway Bridge; generally in accordance with the plan of the district engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable; at an estimated cost to the United States of $5,802,000 for construction and $300,000 for annual maintenance in addition to that now required.

For the Board:

Chas. G. Holle,
Major General, USA, Chairman.

REPORT OF THE DISTRICT ENGINEER

SYLLABUS

Whenever the combined flow of the Missouri and upper Mississippi Rivers becomes less than 63,000 cubic feet per second, deficient depths exist over the lower lock sills of lock and dam No. 26 at Alton, Ill. This condition causes a serious loss of time and money to shippers and waterways operators. Since the dam was put in operation (1938), there has been a total of 330 days of deficient depths and, during the 1955–56 winter season, there were 98 consecutive days when depth over the sills was less than 9 feet. The volume of barge traffic through lock and dam No. 26 is increasing rapidly and the increase is expected to continue until the capacity of the existing locks is exceeded. Several plans for correcting deficient depths were investigated, and it was found that a rock-fill dam located about 900 feet below Chain of Rocks Highway Bridge could be constructed in minimum time and at minimum cost. A dam of this type, at this site, is recommended for construction. The dam would have a fixed-crest elevation of 395 feet mean sea level and a 700-foot fixed spillway section to facilitate passage of ice and silt. It would raise the low-water to elevation 395 feet mean sea level over the lower lock sills at lock No. 26 and thus provide adequate depths, even with the combined flow of the Mississippi and Missouri Rivers as low as 40,000 cubic feet per second. Initial cost to the Federal Government is estimated to be $5,810,000 and annual charges $516,000. A benefit-to-cost ratio of 5.0 to 1 is indicated.

CORPS OF ENGINEERS, UNITED STATES ARMY,
OFFICE OF THE DISTRICT ENGINEER, ST. LOUIS DISTRICT,
St. Louis, Mo., March 26, 1956.

Subject: Mississippi River between St. Louis, Mo., and lock and dam No. 26 (interim survey report)

Through: Division engineer, Lower Mississippi Valley Division, Corps of Engineers, United States Army, Vicksburg, Miss.

To: The Chief of Engineers, Department of the Army, Washington 25, D. C.

1. *Authority.*—This report is authorized by Senate Public Works Committee resolution adopted December 6, 1955.

> *Resolved by the Committee on Public Works of the United States Senate,* That the Board of Engineers for Rivers and Harbors, created under section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby, requested to review the report of the Chief of Engineers on the Mississippi River between Ohio River and mouth of Missouri River, submitted as House Document Numbered 231, Seventy-sixth Congress, First Session, and other reports with a view to determining the advisability of modifying the existing project at the present time, with particular reference to the needs of navigation in the reach of the river between St. Louis, Missouri, and lock and dam No. 26.

2. On December 15, 1955, the Chief of Engineers directed immediate preparation of a report of survey scope. On January 26, 1956, submission of an interim report, covering temporary measures and their relation to possible permanent works, was approved. This interim report may be followed by a final report if continuing study of the effects of any temporary improvements recommended indicate that further improvements will be required. The geographic scope of the report is limited to the section of the Mississippi River between the Chain of Rocks waterworks at St. Louis, Mo., and lock and dam No. 26, Alton, Ill.

3. Available hydrographic and hydrologic data covering a long period of record were used in this investigation. Some additional hydrographic surveys were made. There are adequate existing maps and logs of rock borings on file in the St. Louis district office. The river reach is also shown on United States Geological Survey quadrangle "Missouri-Illinois, Alton." Consultations were held with

navigation interests, city and municipal officials, levee district commissioners, bridge owners and other local interests during preparation of the report.

4. *Description.*—The Mississippi River rises in Minnesota and flows southward about 2,500 miles to the Gulf of Mexico. The river is improved for barge navigation to Minneapolis, Minn., about 1,836 miles from the gulf. The section considered herein lies about 1,173 to 1,186 miles from the Gulf of Mexico. Mileages used hereinafter refer to distance above the mouth of Ohio River to correspond with the official mileage system in use on the upper Mississippi River. Lock and dam No. 26 at mile 202.7 is the lowermost dam of the upper Mississippi River canalization project. Below that point, the river has been improved by open river regulation and dredging. The Missouri River enters from the west at mile 195.0. The Chain of Rocks lateral canal, which lies parallel to Mississippi River on the left between mile 194.0 and mile 184.0, provides a slack-water bypass for the Chain of Rocks reach which has always presented difficulties to navigation. The section of river under consideration is crossed by three bridges. The Lewis and Clark Highway Bridge immediately below lock and dam No. 26 and the Chain of Rocks Highway Bridge at mile 190.5 are high-level spans with adequate horizontal and vertical clearances for navigation. The Missouri and Illinois Bridge and Belt Railroad Co. bridge over the lower approach to lock No. 26 is a swing span with a pivot pier in the intermediate lock wall.

5. At the site of lock and dam No. 26, discharges have varied from about 8,000 cubic feet per second to an estimated 570,000 cubic feet per second, the latter having occurred during the floods of 1851 and 1858. Stages have varied from elevation 391.3 mean sea level, observed during the 1940 low water, to elevation 432.4 mean sea level observed in the flood of 1844. At the Chain of Rocks gage (mile 190.5) discharge has varied from about 20,000 cubic feet per second to an estimated 1,300,000 cubic feet per second during the flood of 1844. Stages at Chain of Rocks have varied from elevation 386.7 mean sea level to elevation 426.5 mean sea level. Under present conditions with floods confined by levees, it is estimated that the maximum flood of record would attain stages of elevation 439.2 mean sea level at Chain of Rocks and 443.4 mean sea level at lock and dam No. 26. The average flow of the Mississippi River at Chain of Rocks is about 170,000 cubic feet per second. At bankfull stage the channel capacity is about 515,000 cubic feet per second.

6. The upper Mississippi River carries a relatively small load of sediment, either in suspension or as bed load. The Missouri River carries an average load of about 310 million cubic yards annually of which about 0.4 percent is bed load. The sediment in suspension is subject to deposition when current velocities are reduced. Both the Missouri and upper Mississippi Rivers discharge considerable volumes of ice. Ice from the upper Mississippi is generally broken up by passage through the dams, and large ice flows occur only for short periods in the spring breakup. The Missouri River contributes larger flows for longer periods of time. Gorges which block movement of navigation on the upper Mississippi have formed from time to time in the past, but navigation has been kept open for through traffic to Chicago throughout most winters since 1940.

7. The low-water plane through St. Louis Harbor and the Chain of Rocks section has been lowering steadily over many years as a result

of channel constriction and scour. Increasing difficulty of navigation through the Chain of Rocks and the rapidly growing movement of river traffic led to adoption of the Chain of Rocks lateral canal. The low-water plane between the mouth of Missouri River and lock and dam No. 26 has lowered rapidly since about 1932 as a result of channel regulation works in that reach. This lowering of the low-water plane, together with subnormal discharges during several recent winters, has reduced the available depth over the lower sill at lock and dam No. 26 to less than the authorized project depth of 9 feet for relatively long periods of time. The progressive lowering of the low-water plane at Alton and St. Louis is illustrated by plates 1, 2A, and 2B.

8. *Prior reports.*—The most recent reports pertaining to navigation in the section concerned are contained in House Document No. 231, 76th Congress, 1st session, which also includes a list of pertinent prior reports. The reports in House Document No. 231 recommended the Chain of Rocks lateral canal which has been constructed. The reports also discussed recession of the low-water plane and possible future need for a dam in the main channel to provide adequate depths from the head of the canal to lock and dam No. 26.

9. *Existing projects.*—The section of Mississippi River under review in this report is covered by four projects for navigation improvement. The River and Harbor Act of January 21, 1927, provides for a channel 9 feet deep and 300 feet wide between the Ohio River and the northern boundary of St. Louis (mile 191). The River and Harbor Act of July 3, 1930, provides for a depth of 9 feet and a width of 200 feet with widening around bends from the northern boundary of St. Louis to the Illinois River (mile 218) as part of the Lakes to Gulf Waterway. The act of August 30, 1935, provided for a depth of 9 feet with widths adequate for long haul common carrier service from the mouth of Missouri River to Minneapolis, Minn. The River and Harbor Act of March 2, 1945, added the Chain of Rocks lateral canal to the main stem improvements previously authorized. The Missouri River, tributary within the section under review, is being improved for 9-foot navigation.

10. Waterborne commerce in the middle and upper Mississippi River developed rapidly after completion of the slack-water project in the upper Mississippi and Illinois Rivers. Prior to World War II, very little navigation moved during the winter months because of the danger to river craft caused by ice. Since that time, because of increased shipping demands and the use of more powerful steel-hull towboats and heavier steel barges, year-round shipping has been maintained through the Mississippi River and the Illinois Waterway to Chicago. The rapid increase in river traffic can be noted from the following tabulation which lists the commerce passing through lock and dam No. 26 from 1938 through 1955.

Freight and vessels, lock No. 26

Year	Lockages	Tonnage	Year	Lockages	Tonnage
1938	2,487	1,369,459	1947	3,235	4,462,774
1939	3,056	[1] 1,747,361	1948	3,786	5,585,120
1940	3,626	2,125,264	1949	3,496	5,623,688
1941	3,814	[1] 2,236,847	1950	4,792	8,275,790
1942	4,003	2,348,431	1951	4,580	9,411,379
1943	3,350	2,312,681	1952	5,604	9,687,869
1944	3,540	2,535,817	1953	5,434	11,142,479
1945	3,337	2,587,408	1954	6,355	12,903,136
1946	3,615	3,530,468	1955	6,296	15,193,756

[1] Estimated figures.

11. Based upon continued expansion of the national economy and the observed growth of river traffic, it is now estimated that there will be a total annual movement of about 26 million tons through lock and dam No. 26 by 1963. It is further estimated that such a volume of traffic would require about 10,000 lockages per annum which, on the basis of past experience, would require about 1,000 lockages per month during the busiest months. These estimates are significant in that they indicate an early need for increased lockage capacity.

12. *Vessel traffic.*—The types and dimensions of river craft operating in this section of river are typical of those used on other inland waterways where comparable channel dimensions are maintained. These craft range from small gasoline powered pleasure boats to commercial towboats, generally diesel driven, having from 300 to 4,200 horsepower. The less powerful towboats are generally 15 to 22 feet wide and 50 to 95 feet long, with 4- to 7-foot draft. The larger and more powerful ones are about 40 to 45 feet wide, 200 to 215 feet long, and draw from 7½ to more than 9 feet. The maximum vertical dimension is 40 to 45 feet. Cargo is carried in steel barges which are lashed together to form fleets or tows pushed by the towboats. Usual barge sizes are 26 by 175 feet and 35 by 195 feet and a larger barge, about 50 feet in width and up to 290 feet in length, is coming into widespread use in the oil trade. Barges normally are designed for a draft of 9 feet, but many newer barges can be loaded to drafts in excess of 10 feet. When river stages permit, maximum draft is used for destinations below lock and dam No. 26 and some barges in excess of 9-foot draft have been passed through lock No. 26.

13. The 110- by 600-foot locks at and above lock and dam No. 26 can accommodate a towboat and barges carrying about 10,000 tons in a single lockage. Larger tows of 20,000 tons or more, which are in common use and are readily manageable in the open river and pools between the dams, must be broken into lock-size sections for passage.

14. *Difficulties attending navigation.*—It has been possible to obtain and maintain authorized project dimensions in the open river section and over the lower miter sill at Alton, except when the combined flow of the Missouri and upper Mississippi Rivers becomes less than 63,000 cubic feet per second. The elevation of the lower lock sills is 385.0 feet. Lowering of the low-water plane downstream of lock and dam No. 26 and the low-water flows which have been experienced during the recent prolonged droughts have resulted in sustained periods of less than authorized depths over the miter sills. During the period September 8, 1939, through February 24, 1956, there has been a total of 330 days when there was less than 9 feet over lock sills. The longest continuous

period (98 days) occurred between November 19, 1955, and February 24, 1956, inclusive. The available depths over the sills during these periods have ranged from 6.2 feet to 8.8 feet and have resulted in substantial monetary losses to barge line operators, shippers and, in some instances, to consumers.

15. *Improvements desired.*—A public hearing was held in St. Louis, Mo., on January 17, 1956, to determine the views and desires of local interests relative to the needs of navigation in the river section under consideration. The hearing was attended by 165 persons, representing State and municipal agencies, shippers of grain, petroleum products, bulk chemicals, and coal; inland waterways operators; and small-boat club officials and riparian landowners. The majority of the speakers, who represented waterways operators and shippers, expressed deep concern over the deficient channel depths which existed in the early months of 1954 and throughout the fall and winter of 1955. They claimed substantial monetary losses because of light loading of barges, the necessity of using additional barges to maintain normal delivery schedules, shortage of materials and supplies in certain localities, either because of inability to ship or of delayed shipments, and a loss in revenue to waterways operators because of diversion of shipments to other means of transportation. It was stated that the revenue losses were sufficiently great to cause operating deficits which would eventually lead to higher transportation charges if deficient depths at the lock sills were not corrected.

16. Grain merchants stated that their rural elevators became overloaded because barges were not available to move grain from the elevators to ultimate destination. Because of erratic delivery schedules, public utility operators were unable to unload barges quickly at time of arrival due to overcrowding of docks. Dealers in domestic fuel oils were forced to curtail deliveries to their customers or to obtain fuel by use of other transportation at an increased cost.

17. Objections of a minor nature were offered by riparian landowners who anticipated damage from wave-wash if a slack-water pool were created. One representative of a small-boat club objected to complete blockage of the river which would force small boats to use Chain of Rocks Canal for through travel on the Mississippi River.

18. In view of certain foreseeable disadvantages of a fixed-crest dam, the district engineer asked for an expression of opinion from waterways operators regarding potential blockage by ice upstream of the Chain of Rocks Canal and, also, the probable reaction of using interests if the river were virtually blocked by a dam. A spokesman for the waterways operators stated that if a fixed-crest dam were built at Chain of Rocks, the operators would accept the chance of occasional blockage of the river by ice rather than suffer the losses which result from inadequate depths over Alton lock sills. It was also stated that commercial operators would use Chain of Rocks Canal if a dam were built which would block the river to such traffic.[1]

19. *Plan of improvement.*—Investigation of the many solutions to the problem of providing adequate navigable depths over the lock sills at Alton revealed that the solutions fell into two broad categories—those for which the solution would lie beyond the geographic limits of this reach of river; and those for which the solution would lie in the

[1] Complete transcript of the public hearing is on file in the district engineer office, St. Louis, Mo.

vicinity of the affected area. These categories are further discussed in the following paragraphs.

20. For those solutions which would lie beyond this reach of river, two were investigated in enough detail to eliminate them for the present:

(*a*) Accelerate construction of multiple-purpose reservoirs on nearby tributary streams of the Missouri and upper Mississippi Rivers so that low-water flows could be augmented when required.

(*b*) Increase the diversion from Lake Michigan from its present average authorized volume of 1,500 to 12,000 cubic feet per second. This was the former maximum release prior to an order by the Supreme Court of the United States (made effective December 31, 1938) to reduce flow to present average value.

Both of the foregoing resolutions, although having certain possibilities of success, possess the obvious disadvantage of requiring a relatively long time to accomplish. Increased diversion from Lake Michigan would entail a reversal of a Supreme Court action and new agreements with the Dominion of Canada and the States bordering the Great Lakes.

21. Three different types of solutions were investigated in the second category:

(*a*) The most obvious solution would be to modify the existing locks by lowering the miter sills to compensate for existing and anticipated changes in the low-water plane which would involve an increase in the height of the lock gates. The maximum lowering of sills which could be accomplished without major reconstruction of the lock is estimated to be about 1 foot. During the latest period of deficient depths, the depth over the sill was less than 7 feet and frequently was between 7 and 8 feet. Hence, lowering of 1 foot would be only a partial solution to the problem and was not further considered. Any solution based upon acceptance of a permanently depressed low-water plane must consider the stability of the dam itself under the higher heads thus imposed. An additional head of more than 1 foot would require provision of a weir below the dam to maintain adequate tailwater stages for stability and satisfactory operation of the dam.

(*b*) Construct a new lock with the downstream miter sill to an elevation which would insure adequate depths over the miter sills under present and anticipated low-water conditions. This solution has much merit, especially in view of the rapidly increasing traffic which by 1963 may be expected to reach a saturation point with respect to the practicable capacity of the existing 600-foot lock. It is foreseeable that in the near future the existing locks should be supplemented by a new lock with a length of 1,200 feet. In this type of improvement an auxiliary weir also would be required to limit the head on the dam.

(*c*) Construct a low-water dam without locks below Missouri River at a site about 900 feet below Chain of Rocks Highway Bridge where rock foundation is available. The dam would create a slack-water pool and thus raise the low-water elevation at lock and dam No. 26 to provide necessary clearance over the lower miter sills. The increased elevation of tailwater would eliminate the need for lower miter sill elevations and the auxiliary weir at lock and dam No. 26, but construction of the new 1,200-foot lock would eventually be required.

22. Provision of a low-water dam below the Missouri River in turn leads to consideration of several types of dams as follows:

(*a*) A wicket type of movable dam which has been used on the Ohio River. The Ohio River dams normally are lowered during high flows of the winter season and raised during the low-water season of the late summer and fall. In this section of the Mississippi River they are most likely to be raised during the winter season and would be subject to damage from ice flows during the spring breakup. The heavy silt load of the Missouri River introduces the possibility that the wickets would be made inoperable by sediments moved during high-water season while the dams are in lowered position. Such a dam would be advantageous in that it would permit passage of navigation at comparatively low stages when not in raised position. It also would not form a permanent obstruction likely to cause deposition of sediment during heavy sediment flows and would not encourage formation of ice gorges. Its disadvantages are that it would require a comparatively long period of construction at high cost, would entail high operation and maintenance cost, and be subject to hazardous operating conditions. The wicket type dam would be undependable in that the pool could be lost by the need for lowering the dam to prevent ice damage during the season when low stages are most likely to prevail. The cost of a movable dam is estimated at $12,400,000 for construction with cost of $162,500 annually for operation and maintenance.

(*b*) A fixed-crest concrete overflow weir designed to pass a minimum flow of 40,000 cubic feet per second at a stage that would provide project depth of 9 feet over the lower sill at lock No. 26. The extreme low flow would be passed through a low section of the crest. Navigation could pass over the low section of the dam at stages at or above bankfull. The low-water opening would serve to minimize silt deposition and to reduce the possibility of formation of ice gorges, but would cause some deposition of silt and an increase in the cost of maintenance dredging in the Missouri and Mississippi Rivers above the dam. The cost of such a dam is estimated at about $10,100,000 for construction with $132,500 annually for increased maintenance. This dam would require about 24 to 30 months for construction.

(*c*) A similar fixed-crest weir dam with the low-flow section equipped with tainter gates for dependable control of pool levels and for passage of ice and sediment. This dam would be passable by navigation at high stages, but probably would not be so used except by small craft and by downbound empty tows. The cost of such a dam is estimated at $15,700,000 with $102,500 annually for increased operation and maintenance. This dam would require about 30 to 36 months for completion.

(*d*) A rockfill dam forming a broad-crested weir with low-water section similar to the fixed-crest concrete structure described in subparagraph (*b*) above. This type of dam would have a low initial cost and could be constructed under an accelerated program without the need for cofferdams in a period of 16 to 24 months. The upstream and downstream faces and the crest of the dam would be composed of 5- to 10-ton derrick stone with a less pervious core of smaller stone and quarry waste. The foundation would be the natural rock bed of the river. At the Illinois abutment the rockfill would be tied into the earth bank by means of a section of rockfilled sheet pile cells driven to bedrock, and a sheet piling diaphragm extending about 200 feet into the bank material, as shown on plate 5 of the drawings. At the

Missouri abutment the natural rock bed of the river rises to above the height of the dam. The cost of this dam is estimated at $5,810,000 for construction with annual cost of maintenance at $302,500. This estimate is based on a dam built from shore to shore. The possibility exists that it could be tied into Homer dike, provided that repairs to the dike now being planned by the city of St. Louis would be completed in time to permit such a tie-in. A substantial savings in the Federal cost can be accomplished if this alternative plan can be adopted.

23. The possible plans of improvement previously discussed are summarized as follows:

Type of structure	Initial cost	Total annual charges [1]	Time required (months)
Wicket dam	$12,400,000	$690,000	30 to 36.
Fixed-crest concrete	10,100,000	500,000	24 to 30.
Fixed-crest with gates	15,700,000	680,000	30 to 36.
Fixed-crest rock fill	5,810,000	516,000	16 to 24.

[1] Based on 50-year life and including provision and maintenance of navigation aids.

24. The rockfill dam as shown on plates 4 and 5 represents the most practicable, earliest solution, at minimum cost for initial construction, to the urgent problem of providing adequate navigable depths over the lower sills at lock No. 26. Rating curves used in planning the hydraulic characteristics for the structure are shown on plate 3. The principal characteristics of the dam are as follows:

Total length	2,760 feet.[1]
Length of spillway section	700 feet.
Crest elevation of main dam	395 feet.
Spillway crest elevation	387.7 feet.
Width of crest	30 feet.
Slope of upstream face	1 on 3.
Slope of downstream face	1 on 3.
Total volume of rockfill	265,000 cubic yards.
Sheet piling	400 tons.
Bank revetment	610,000 square feet.

[1] Length would be reduced to 1,760 feet if the dam were attached to Homer dike.

25. The spillway crest elevation of 387.7 feet mean sea level is considered to be the minimum which would provide desired channel depths at Alton with low flow of about 40,000 cubic feet per second. The dam would reduce the channel cross-sectional area about 50 percent at bankful elevation. The computed swellhead caused by the structure would be about 0.3 foot at bankful stage and become negligible at design flood stage adopted for flood protection improvements. At low water the slack-water pool would extend to Alton in the upper Mississippi River and to approximate mile 5 in the Missouri River.

26. In the event a 12-foot navigation project is authorized for this section of the Mississippi River, the spillway crest elevation of the proposed rockfill dam could be retained and the remainder of the dam raised about 2 feet. Such an increase in crest elevation would have the further advantage of raising the low-water elevation in Chain of Rocks Canal and would obviate the necessity for additional dredging in the canal.

27. *Foundation geology.*—The bedrock at the site consists of coarse-grained, crystalline, sandy, and cross-bedded limestones of the Ste.

Genevieve formation. As disclosed in the logs of borings and the foundation of lock No. 27, this limestone contains minor thicknesses of bluish clay-shale. On the right bank the Mississippi River lies along high rock banks, and bedrock extends to the east at the elevation of the present channel bottom and is overlain by pervious alluvial deposits varying from coarse gravels to sandy silts. The thickness of the alluvial deposits above the deepest part of the bedrock is greater than 50 feet. The bedrock is satisfactory as foundation for a rockfill dam and, aside from minor rectifiable defects, is satisfactory for a masonry structure.

28. *Sources of construction materials.*—Stone in the size of 5 to 10 tons has not been produced heretofore in this locality. However, 7 limestone quarry operators who were consulted expressed a willingness to supply the large stone required. The 7 quarries estimated that, in the period of about 18 months, they could supply a combined total of 185,000 tons of acceptable 5- to 10-ton stone at an average cost of $6 to $7 per ton loaded on barges. Stone of smaller dimensions is available in practically unlimited quantities. A granite quarry at Graniteville, Mo., about 75 miles south of St. Louis, has available for immediate shipment 60,000 tons of red granite in blocks 4 by 4 by 4 feet and additional quantities of large stone in less regular shapes. This stone, which is unsuitable for decorative or monument purposes because of variations in color and striation, appears to be excellent material for the dam. The owner of this quarry estimates that it could be delivered via rail to the construction site for about $6 to $7 per ton.

29. *Construction phasing.*—The building of the rubble-type dam herein proposed requires careful planning and phasing of the construction schedule because cofferdams are not contemplated. The construction work would thus be vulnerable to attack by currents, and structural stability must be maintained at all times. Based upon best information available, it is believed that construction should be undertaken in the following order:

(*a*) Bank realinement and construction of revetment to be the first operation while the contractor is securing steel sheet piling for the abutment. This revetment work should be initiated at the lower end of the existing revetment above the bridge and proceed continuously downstream under the assumption that it will be substantially completed by the time the sheet piling is available.

(*b*) Install sheet piling.

(*c*) Tie in sheet piling abutment section with bank protection by placement of additional stone and mattress.

(*d*) Start construction of stone fill in deepest water and proceed toward the Missouri shore, placing first the heavy stone for the downstream portion of the base, then smaller stone for core of dam, and finally the upstream heavy stone face, all in courses kept to uniform elevation. To guard against developments resulting from fluctuating river stages or construction procedures, material should be stockpiled in sufficient quantities for rapid placement.

30. *Aids to navigation.*—The district commander, United States Coast Guard, was furnished a description of the proposed dam and anticipated effects, particularly with respect to potential hazards to navigation. Downbound traffic should be diverted at mile 195 into the upper entrance of the Chain of Rocks Canal. This would require a line of buoys, extending from the right bank below the mouth of

Missouri River to the point of land on the left bank at the upper entrance to the canal. It is estimated that 3 lighted and 9 unlighted can buoys, with normal markings for the right descending side of the channel, will be required at an estimated cost of $8,000 for initial installation with annual maintenance and replacement of $2,500. In addition, provision has been made in the estimated initial cost of the dam for the installation on the Chain of Rocks and Merchants Bridges of electric signs to warn upbound and downbound traffic of the presence of the dam.

31. *Estimates of first cost and annual charges.*—There is given in the table below general estimate of initial cost and annual charges for the project consisting of a rockfill dam as follows:

Classification:	
01 Lands and damages	$4,600
04 Dams	4,320,000
08 Roads	14,000
09 Channels and canals (bank protection)	792,000
30 Engineering	211,000
31 Supervision and administration	460,400
Subtotal	5,802,000
First cost, construction	5,802,000
Interest during construction (½ of 20 months at 2½ percent)	241,800
Navigation aids	8,000
Total Federal investment	6,051,800
Annual charges, Federal:	
Interest at 2½ percent	151,300
Amortization, 50 years (0.01026)	62,100
Maintenance:	
Dredging	100,000
Revetment	25,000
Dam	175,000
Aids to navigation	2,500
Total annual charges	515,900
Say	516,000

32. *Allocation of costs.*—All costs contained in the foregoing estimate of first cost are for construction of the required rockfill dam except the costs of about 5 acres of right-of-way on the Illinois shore for a storage yard and access road which will be required for construction and maintenance of the dam. In view of the use to which this land will be put, it is believed that the land should be acquired at Federal expense and that there should be no local contribution toward the improvement.

33. *Estimates of benefits.*—Inadequate depths over the lock sills result in losses to waterway operators and the consuming public which fall into several categories as follows:

(*a*) Reduced draft of barges which results in higher unit costs for the cargo carried.

(*b*) Costs of lightering in which barges are lightened for passage through the locks and then reloaded. This procedure is particularly adaptable to petroleum cargoes which may be transferred by pumping.

(*c*) Idle time of towing equipment measured by interest on and amortization of costs of the equipment, plus crew wages and other necessary operating expenses during enforced idleness.

(*d*) Added cost to consumers of substitute means of transporting cargo.

(*e*) Other business losses due to disruption of shipping schedules, shortages of materials, and overcrowding of terminal facilities.

34. A study of the duration of discharges at lock and dam No. 26 and resulting stages based on present channel conditions indicated that depths of less than 9 feet over the lower lock sill will prevail for about 33 days per year, with an average depth of 7½ feet and with minimum depths as low as 6 feet. In order to obtain an estimate of benefits during a typical period of deficiency, barge line operators and other shipping interests were requested to submit their estimates of losses during the 30-day period November 20–December 19, 1955. During this period the actual mean depth over the lower sill was 7.97 feet with a minimum of 7.4 feet. Forecasts of depths as little as 6½ feet were given to shippers during this period based upon extremely cold weather which fortunately did not materialize. These conditions are considered reasonably representative of a normal winter deficiency period. Reports received from shippers, representing about 65 percent of the total traffic through lock No. 26 during the 30-day period, showed the following losses:

Nature of loss:	Shippers evaluations
Reduced draft barges	$583, 300
Lightering of cargo	51, 400
Costs of idle equipment	317, 600
Additional cost of supplementing deficient deliveries by rail	112, 500
Other business losses	32, 300
Total	1, 097, 100

35. Examination of the estimates summarized above indicates that the reported losses were based on underloading approximately 25 percent of barge capacity and a loss of revenue at an average rate of 2.8 mills per ton-mile. This was accepted as a reasonable basis for evaluation. Assuming similar experience by firms which did not report or evaluate their losses, the total loss due to reduced draft has been estimated as $865,000.

36. The above estimates by shippers evaluated the losses due to lightering and delayed equipment primarily on charges per barge-day or towboat-day of idle time of delayed equipment and of the additional barge equipment required for the lightering operations. Some small items of cost were reported for actual transfer of cargo, but these costs are not significant in comparison with the standby cost of the equipment. The standby charges used by the shippers and the estimates of equipment days involved were examined and found reasonable. Extension of the reported experience to other tonnage passing lock and dam No. 26 during the 30-day period results in an estimated total loss of $550,000 due to lightering and idling of equipment.

37. Five firms in the Chicago area reported that during the serious shortage of fuel in that area they were forced to ship products by rail at a cost of $112,500 in excess of their normal cost of moving the same traffic by barge. Due to the sudden heavy demand on rail equipment a tank-car shortage developed to the extent that petroleum products were rationed and some businesses were forced to close for short periods. A substantial amount of coal which normally would have been loaded at a barge terminal about 75 miles below St. Louis was

moved by rail for loading onto barges above lock No. 26. The cost of this additional rail haul was not reported. Other business losses were reported due to substitution of higher grade petroleum products to meet essential needs of some users in the shortage areas. The coverage of businesses' losses reported by shipping interests is obviously incomplete, but the reported figure of $144,800 will be used in the interest of conservatism.

38. It is believed that the total losses of $1,559,800 described in the preceding paragraphs represent a conservative estimate of actual losses during a typical 30-day period of deficient stages based on 1955 traffic conditions and price levels. Traffic has grown rapidly in the past as shown in paragraph 10 and continued growth to the potential capacity of the lock of about 26 million tons annually may be expected within a reasonably short period of time. Based upon an average annual tonnage of 25,100,000 tons during the useful life of the proposed improvement, it is believed that the tonnage during a typical 30-day winter deficiency period should be increased about 65 percent over the tonnage reported in the 1955 period, and that a loss of about $2,570,000 is a reasonable and conservative estimate of benefits to be obtained by the proposed improvement.

39. *Economic justification.*—Based upon the plans and estimates of cost presented in paragraphs 22 and 23 and the benefits discussed in paragraphs 35 to 38, benefit-to-cost ratios of the four most practicable plans of improvement are as follows:

Type of dam	First cost	Annual charges	Annual benefits	Benefit-cost ratio
Wicket	$12,400,000	$690,000	$2,570,000	3.7 to 1.
Fixed-crest concrete	10,100,000	500,000	2,570,000	5.1 to 1.
Fixed-crest weir with tainter gates	15,700,000	680,000	2,570,000	3.8 to 1.
Rubble masonry	5,810,000	516,000	2,570,000	5.0 to 1.

40. *Coordination.*—The damsite was selected after discussion with the water department of St. Louis to avoid interference with the functioning of Chain of Rocks intake towers and the water-supply system. The effects on silting in the pool area were discussed with representatives of the district engineer, Kansas City district. The type of dam and the hazards it would present to navigation were discussed with navigation interests and the United States Coast Guard. Bridge owners, levee district commissioners, and small-boat operators also were consulted regarding the effects of the structure on their individual and collective operations. The United States Fish and Wildlife Service stated that it had no interest in the proposed dam.

41. *Discussion.*—When the combined flow of the upper Mississippi and Missouri Rivers is less than 63,000 cubic feet per second, depths of less than 9 feet occur over the lower miter sill at lock No. 26 and prevent through movement of barges loaded to drafts which can safely pass through the canalized upper Mississippi and Illinois Rivers. Deficiencies may be expected to occur about 33 days per year during the winter season, and under severe conditions as little as 6 feet will be available over the miter sill. The river now carries heavy traffic which is growing rapidly in volume. It is estimated that an average annual loss to shippers of about $2,570,000 in the future will occur if deficient depths continue. Drought conditions of recent occurrence have caused an unusual and serious deficiency in depths, and shipping

interests are seriously concerned over the earliest possible provision of corrective measures. It is impracticable to provide relief by constructing storage reservoirs or other means of increasing low-water flows within a reasonable time. Any proposal to lower the elevation of the lock sills by a sufficient amount to provide a complete solution would require costly and time-consuming alterations or supplemental structures to assure the stability of dam No. 26. Such a solution would be provided by construction of a new 1,200-foot lock and auxiliary weir which probably will be found necessary in the near future. However, this construction would not afford the immediate relief considered necessary. Provision of a dam in the main channel below the mouth of Missouri River to create slack-water project depths over the lock sills and assure stability of dam No. 26 offers a complete solution within a reasonably short period of time.

42. Four possible dams for this locality have been studied in some detail. The wicket dam, although possessing certain advantages, has relatively fragile wickets and is hazardous to operate. It is, therefore, questionable as the most suitable structure for this locality where heavy ice flows have been experienced. Two of the dams having fixed crests have substantially the same effects on the river and about equal annual costs, but one, a rockfill dam, has only about half the initial cost of a more elaborate masonry structure. It has the added advantage that it can be constructed in a much shorter time to provide the urgently desired relief. It is the considered opinion of the district engineer and personnel of other offices of the Corps of Engineers, who have been consulted, that the rockfill dam could be constructed successfully and is the most practicable means of providing immediate benefits.

43. At the request of the Water Department of the city of St. Louis, the damsites considered have been limited to locations below the waterworks intakes. The dams proposed would cross a trail dike originally built by the water department which, being no longer required, would be removed by the Federal Government. It is possible that in the course of final design the proposed rockfill dam may be tied into another rock dike (Homer dike) which the water department plans to rehabilitate and reinforce. This would result in a substantial saving in estimate of the Federal cost of the dam as proposed. Although the water department has expressed a willingness to cooperate in such a plan, it should not be adopted without definite assurance that rehabilitation of Homer dike will be completed prior to or simultaneous with the construction of the dam. In case of the tie-in formal agreements or contracts should be made between the water department and Corps of Engineers to confirm this presently expressed willingness of the water department to cooperate by rehabilitating its dike to acceptable standards and to guarantee its continued maintenance.

44. The possibility exists that any dam in this area may cause silting upstream and there may result occasional blockage of the channel by ice. It is believed that the regimen of the river will become adjusted and that there will be no tendency to worsen progressively.

45. Navigation interests have strongly urged immediate relief. Estimates of damage to present navigation movement show that improvement is thoroughly justified and that the cost of an improvement capable of affording relief at an early date will be recovered in benefits in a very short period of years. Construction of the rockfill dam as proposed herein will give immediate relief at minimum initial

cost and will afford the opportunity for further adjustment to meet unforeseen developments and possible requirements for a deeper navigation project in future years.

46. *Conclusions.*—Based upon the foregoing discussion, it is concluded that—

(*a*) The most rapid and practicable means of providing project depths over the lower miter sills of lock and dam No. 26 would be a low-water dam in the Mississippi River about 900 feet downstream of Chain of Rocks Bridge, as shown on plate 5.

(*b*) The least costly structure to accomplish this purpose would be a rockfill dam at an estimated cost of $5,810,000 with annual charges estimated at $516,000 and a benefit-to-cost ratio of 5 to 1.

(*c*) A number of problems will require further study, including control of siltation, passage of ice flows, reduction of maintenance dredging, and possible need of additional pile dikes above Missouri River. These studies are operational in nature and will not require further report unless a substantial change in the improvement recommended herein is found necessary.

47. *Recommendations.*—It is recommended:

(*a*) That a fixed-crest rockfill dam with 700-foot spillway be constructed approximately 900 feet below Chain of Rocks Bridge at an estimated first cost to the Federal Government of $5,802,000.

(*b*) That funds be made available at the earliest practicable date for initiation of construction.

(*c*) That continuing study be made of the problems to determine the most efficient comprehensive plan of development for this section of the Mississippi River, including the need for additional lockage facilities at dam No. 26.

George E. White, Jr.,
Colonel, Corps of Engineers, District Engineer.

[First endorsement]

Office, Division Engineer,
Lower Mississippi Valley Division,
Corps of Engineers,
Vicksburg, Miss., March 30, 1956.

Subject: Mississippi River between St. Louis, Mo., and lock and dam No. 26 (interim survey report)

To: Chief of Engineers, Department of the Army.

The findings and recommendations of the district engineer are concurred in.

John R. Hardin,
Major General, USA,
Division Engineer.

LIST OF ILLUSTRATIONS MADE IN CONNECTION WITH THE REPORT OF THE DISTRICT ENGINEER

(Only pls. 4 and 5 printed)

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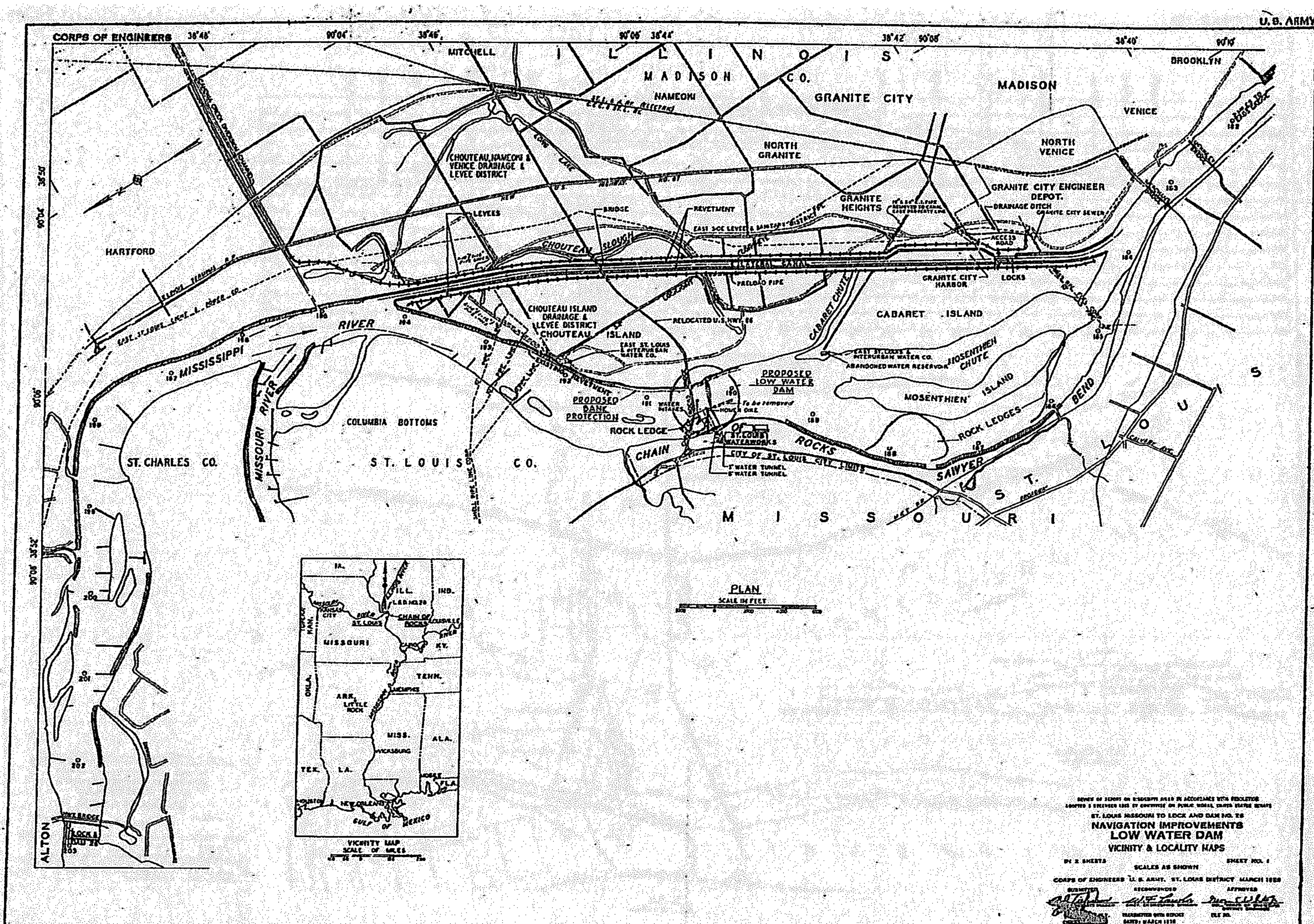
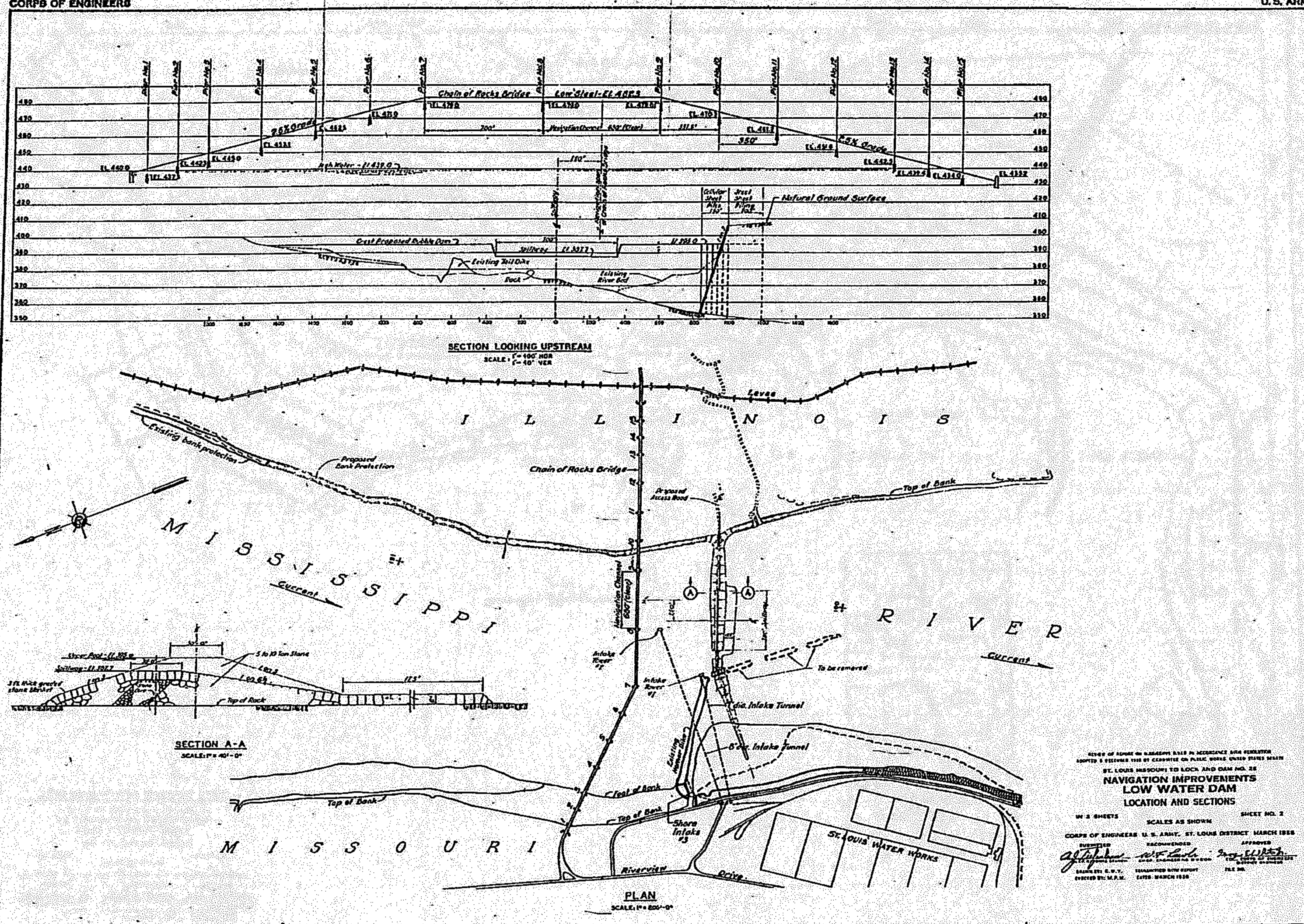

ILLINOIS
MADISON CO.
MITCHELL
NAMEOKI
GRANITE CITY
MADISON
BROOKLYN
VENICE
NORTH GRANITE
NORTH VENICE
CHOUTEAU, NAMEOKI & VENICE DRAINAGE & LEVEE DISTRICT
GRANITE HEIGHTS
GRANITE CITY ENGINEER DEPOT.
DRAINAGE DITCH
GRANITE CITY SEWER
ACCESS ROAD
HARTFORD
LEVEES
BRIDGE
REVETMENT
CHOUTEAU SLOUGH
LATERAL CANAL
GRANITE CITY HARBOR
LOCKS
CABARET ISLAND
CABARET CHUTE
CHOUTEAU ISLAND DRAINAGE & LEVEE DISTRICT
CHOUTEAU ISLAND
RELOCATED U.S. HWY. 66
EAST ST. LOUIS & INTERURBAN WATER CO.
ABANDONED WATER RESERVOIR
MOSENTHIEN CHUTE
MOSENTHIEN ISLAND
PROPOSED LOW WATER DAM
PROPOSED BANK PROTECTION
To be removed
ROCK LEDGE
ROCK LEDGES
CHAIN OF ROCKS
ST. LOUIS WATERWORKS
CITY OF ST. LOUIS CITY LIMITS
WATER TUNNEL
SAWYER BEND
MISSISSIPPI RIVER
MISSOURI RIVER
COLUMBIA BOTTOMS
ST. CHARLES CO.
ST. LOUIS CO.
ST. LOUIS
MISSOURI
ALTON
LOCK & DAM 26
PLAN
SCALE IN FEET
IA.
ILL.
IND.
L.& D. NO. 26
CHAIN OF ROCKS
ST. LOUIS
KANSAS CITY
MISSOURI
KY.
TENN.
OKLA.
ARK.
LITTLE ROCK
MEMPHIS
MISS.
ALA.
VICKSBURG
TEX.
LA.
NEW ORLEANS
GULF OF MEXICO
FLA.
VICINITY MAP
SCALE OF MILES
ST. LOUIS MISSOURI TO LOCK AND DAM NO. 26
NAVIGATION IMPROVEMENTS
LOW WATER DAM
VICINITY & LOCALITY MAPS
IN 2 SHEETS
SHEET NO. 1
SCALES AS SHOWN
CORPS OF ENGINEERS U.S. ARMY, ST. LOUIS DISTRICT
SUBMITTED
RECOMMENDED
APPROVED


Chain of Rocks Bridge
Natural Ground Surface
Crest Proposed Rubble Dam
Spillway
Existing Toll Dike
Rock
Existing River Bed
SECTION LOOKING UPSTREAM
Levee
I L L I N O I S
Existing bank protection
Proposed Bank Protection
Chain of Rocks Bridge
Proposed Access Road
Top of Bank
M I S S I S S I P P I
Current
R I V E R
Current
Navigation Channel 600' (Clear)
To be removed
Intake Tower #2
Intake Tower #1
Intake Tunnel
Foot of Bank
Top of Bank
Shore Intake #3
M I S S O U R I
St. LOUIS WATER WORKS
Riverview Drive
Top of Rock
SECTION A-A
SCALE: 1" = 40'-0"
PLAN
ST. LOUIS MISSOURI TO LOCK AND DAM NO. 26
NAVIGATION IMPROVEMENTS
LOW WATER DAM
LOCATION AND SECTIONS
SHEET NO. 2
SCALES AS SHOWN
CORPS OF ENGINEERS U.S. ARMY, ST. LOUIS DISTRICT
SUBMITTED
RECOMMENDED
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